

Title:

5 **Apparatus and method for the production of a multi-
component extrusion with capstock coating including
snap-in connector and product so produced**

10 This application claims priority of the filing date of
co-pending US Patent Application 60/420,484.

TECHNICAL FIELD

15 This invention relates to methods and apparatus for
forming a multi-component extrusion and the multi-
component extrusion so produced. More specifically the
invention relates to methods and apparatus for forming a
snap-connector from a capstock material that is co-
extruded with an extruded profile formed from a
20 different extrudable material.

BACKGROUND OF THE INVENTION

25 Milled wood products have formed the foundation for
the fenestration, decking, venetian blinds, shutters,
decking and remodeling industries for many years.
Historically, ponderosa pine, fir, red wood, cedar and
other coniferous varieties of soft woods have been
employed with respect to the manufacture of residential
30 window frames, residential siding, outer decking and
exterior shutters as well as interior venetian blinds
and shutters. Wood products of this type inherently
possess the advantageous characteristics of high
flexural modulus, good screw retention, easy workability
35 (e.g., milling, cutting, paintability), and for many
years, low cost. Conversely, wood products of this type

0 have also suffered from poor weatherability in harsh
climates potential insect infestation such as by
termites, and high thermal conductivity. In addition,
virgin wood resources have become scarce causing
correspondingly high material costs.

5 In response to the above described disadvantages of
milled wood products, the fenestration industry, in
particular, adopted polyvinyl chloride (PVC) as a raw
material. Hollow, lineal extrusions manufactured into
window frames became an enormous success, particularly
10 at the lower end of the price spectrum. The window
frames made from hollow PVC lineals have exhibited
superior thermal conductivity, water absorption
resistance, rot and insect resistance, and ultraviolet
radiation resistance compared to painted ponderosa pine.
15 Although such extrusions further enjoyed a significant
cost advantage over comparable milled wood products,
these PVC products had a significantly lower flexural
modulus and higher coefficient of thermal expansion and
were difficult to paint effectively.

20 By the mid-1990's, a number of window and door
frame manufacturers attempted to combine the most
desirable characteristics of extruded thermoplastic
polymers and solid wood frame members by alloying PVC
with wood flour or other fillers. Further, many
25 manufacturers have produced solid (i.e., non-hollow)
lineal extrusions typically either out of a foamed PVC
and wood alloy or of a foamed PVC (or another
thermoplastic resin). Both of these solutions can
increase the strength of the profile while keeping the
30 overall cost of the extrude lineal as low as
practicable. In any of these cases, the foamed or wood
composite lineal extrusion will typically need to be
capstocked with a weather-proof thermoplastic coating or
else the lineals will need to be painted. The preferred

0 practice is to capstock the lineal by co-extruding a
thin layer of PVC resin or other weatherable
thermoplastic that includes various ultraviolet
radiation inhibitors to provide a smooth, aesthetically
pleasing, durable exterior surface. The capstock
5 material is fed into the extrusion die by a separate
capstock extruder and the capstock material is typically
fed around the foamed or composite extrusion profile and
is held in place against the foamed or composite profile
by the extrusion die walls. The capstock material flows
10 around and takes its shape substantially from the shape
of the foamed or composite extrusion profile. The
pressure provided by the capstocking extruder forces the
capstock material into the die and the capstock material
flows around the exterior of the foamed or composite
15 extrusion profile.

The use of hollow thin wall extruded profiles
allowed changes to the way the window frames were
connected to various window frame accessories such as
glazing beads, stucco beads or even nail fins. One
20 convenient method allowed by the extrusion process is
the "snap-in" connector. The snap-in connector has a
male prong or prongs which jut out from a side of an
extruded profile and typically extend the length of such
an extruded profile. The prongs compress when inserted
25 into a female snap-in connector slot which extends the
length of another profile. These male prongs are
relatively easily added to a hollow wall extrusion as
the prongs can be extruded from the same material,
typically PVC resin, that is used for both the walls and
30 the prongs of the extruded profile. The thickness of
the prongs are relatively comparable to the thickness of
the walls of the extruded profile allowing the extrusion
die to feed both the prongs and the main walls without
significant difficulties.

0 In a multi-component extrusion where the interior
portion of the extruded profile is a foamed
thermoplastic resin, a foamed thermoplastic resin and
wood flour composite, or a non-foamed thermoplastic
resin and wood flour composite, this interior compound
5 is not suitable for extruding into the thin elongated
prongs required for the male portion of the snap-in
connector. The prior art practice that applies a
capstock material to the extrusion profile and uses the
existing profile to shape and force the thin layer of
10 capstock material against the walls of the extrusion die
is unable to produce the prongs of the male connector.
The prior art die designed to supply a thin capstock
layer to the exterior of a profile is unable to supply
enough capstock material to form the relatively thick
15 and extended prongs required for the prong or prongs of
a snap-in connector. Using prior art processes, the
prongs of the snap-in connector will not fill in
properly with capstock material in a production setting.

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SUMMARY OF THE INVENTION

One embodiment of the invention disclosed herein is
a multi-plate extrusion die of the type having upstream
25 and downstream directions, and includes a primary
aperture for passage through the die of a primary
extrudate. The primary aperture extends longitudinally
through the die and the primary extrudate is formed into
a profile having a prong mounting face by the primary
30 aperture. A base capstock conduit feeds a capstock
extrudate, where the base capstock conduit joins with
the primary aperture and applies a base capstock coating
of the capstock extrudate on the prong mounting face of
the primary extrudate. A prong capstocking conduit

0 feeds the capstock extrudate, forms at least one prong,
and meets with the base capstocking aperture downstream
of where the base capstocking aperture meets the primary
aperture containing the primary extrudate. Therefore,
the prong is attached to the base capstock coating on
5 the mounting face of the primary extrudate.

A further embodiment of the invention is a method
for forming a multi-component extrusion having snap-in
connectors, which includes forming a primary extrusion
profile from a primary extrudate where the primary
10 extrusion profile has a mounting face, forming a base
capstock layer from a capstock extrudate on at least the
mounting face of the primary extrusion profile, and then
forming a capstock prong from a capstock extrudate and
attaching the capstock prong to the base capstock layer.
15 Thus a final extrusion profile is co-extruded whereby
the primary extrusion profile, the base capstock layer
and the capstock prong are joined in a molten, plastic
state and where the prong formed from a capstock
material is attached to the base capstock layer also
20 formed from the capstock material where the base
capstock layer is already applied to the primary
extrusion profile formed of the primary extrudate.

A still further embodiment of the invention is a
multi-component extrusion having at least one snap-in
25 connector prong. The multi-component extrusion includes
a primary extrusion profile having an outer surface of a
predetermined shape including a mounting face and is
formed of a primary extrudate. An exterior capstock
layer is formed from a capstock extrudate and is formed
30 over and surrounds at least the mounting face of the
primary extrusion profile. At least one prong for a
snap-in connector is formed of the capstock extrudate
and is attached to the capstock layer attached to the
mounting face of the extrusion profile.

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BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an environmental, isometric view of a preferred embodiment of the inventive multi-component
5 extrusion profile with a male snap-in connector formed from a capstock material.

Figure 2 is a plan view of a snap-in connector of the inventive multi-component extrusion showing both the male and female portions of the connector.

10 Figure 3 is an exploded schematic representation of a plurality of extrusion die plates employed in the manufacture of the extrusion shown in Figure 1.

Figure 4 is an isometric view of a mandrel plate that is one of the extrusion die plates of Figure 3.

15 Figure 5 is an isometric view of a representation of the material flow through the conduits and apertures of the extrusion plates of Figure 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

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In Figure 1, a preferred embodiment of the inventive multi-component composite continuously lineal extrusion is generally indicated at reference numeral 10 having a interior foamed portion 12 and a capstock 14
25 with prongs 16 and 17 of a male portion of the snap-in connector 18. The capstock portion 14 surrounds the entire interior foamed portion 12 and includes male prongs 16 and 17 and surface capstock portion 20. It should be noted that the thickness of the surface
30 capstock portion 20 of the capstock 14 is substantially less than the thickness of the prongs 16 and 17. It should also be noted that the invention disclosed, herein, encompasses the use of a non-foamed thin walled

0 hollow extrusion that replaces the foamed portion 12 in
the multi-component extrusion 10.

In Figure 2, an embodiment of the inventive multi-
component composite extrusion 10 with the male prongs 16
and 17 of the male snap-in connector 18 is shown with a
5 corresponding female snap-in connector pocket 22. Prong
16 bends inwardly toward prong 17 and prong 17 bends
inwardly toward prong 16 as the male connector 18 is
inserted into the female connector pocket 22. Each
prong 16 and 17 springs outwardly away from the opposite
10 prong 17 and 16 when fully in the recess of the female
connector pocket 22 and therefore resist being removed.

Figure 3 illustrates a die assembly generally
indicated at reference numeral 23 consisting of
individual die plates 24, 26, 28, 30, and 32, for
15 manufacturing the inventive multi-component extrusion
with a male snap-in connector formed from a capstock
material. The manner of use of such dies is well known
to those of ordinary skill in the thermoplastic
extrusion art and is well described in U.S. Patent
20 Application Serial No. 09/452, 906, entitled "Wood Fiber
Polymer Composite Extrusion and Method" assigned to the
assignee of the present invention. Disclosure of that
application is incorporated herein by reference.
Nevertheless, it is sufficient to state that the die
25 assembly 23 shown in Figure 3 is intended for use with
two conventional extruders, such as conventional twin
screw extruders, each of which includes a mixer or
hopper for accepting a thermoplastic feed stock material
that may or may not include a filler such as wood flour,
30 preferred feed stock materials are disclosed below, a
conduit for connecting the hopper with a preheater for
controlling the temperature of an admixture of the feed
stock in the hopper, and optionally an inlet for
introducing foaming agents in the case of a foamed

0 component. The preheater is connected to the screw
chamber of each extruder so as to pass the feed stock
through to the extruder. The multi-screw chamber of
each extruder is connected to an appropriate one of the
die assembly plates shown in Figure 3 for producing the
5 multi-component extrusion with snap-in connector shown
in Figure 1.

As best seen in Figure 3, one of the herein above
described extruders (not shown) is fluidly connected in
a manner well known and understood in the thermoplastic
10 extrusion art to an introductory plate 24 for
introduction of a primary extrudate, a suitable
formulation of which is disclosed below, through a
primary aperture 34. The primary extrudate may be a
foamed thermoplastic polymer, a thermoplastic and wood
15 flour composite, a foamed thermoplastic and wood flour
composite as is needed or desired by the intended usage
or application for the final extruded multi-component
extrusion. The herein disclosed invention encompasses a
primary extrudate of whatever type or nature where a
20 prong for a snap-in connector is co-extruded with the
primary extrudate and the prong is formed from a
capstock material. Introductory plate 24 is fluidly
connected to a mandrel plate 26 that supports a mandrel
36 by means of a plurality of longitudinally elongated
25 fins 38 within the primary conduit 40. Mandrel plate 26
is broken out and shown in detail in Figure 4. The
primary extrudate flows through the primary aperture 34
into the primary conduit 40 and therein flows in contact
with the length of mandrel 36, as the primary conduit 40
30 extends through mandrel plate 26, first capstock plate
28, second capstock plate 30, and exit die plate 32.

Also shown in Figure 3 are first and second
capstock plates, 28 and 30 respectively, and exit die
plate 32. An additional extruder (not shown) as

0 described herein above is fluidly connected out to the
bottom of the first capstock plate 28 to a primary
capstocking conduit 42. Primary capstocking conduit 42
is fluidly connected to prong capstocking conduits 44,
top capstocking conduits 46, base capstocking conduit
5 48, and side capstocking conduits 50. Prong capstocking
conduit 44 and top capstocking conduit 46 continue from
mandrel plate 26, through first and second capstock
plates 28, 30 and meet with the primary conduit 40 in
exit die plate 32. The top capstocking conduit 46 meets
10 with the primary conduit 40 within the exit die plate 32
and the capstocking extrudate meets the primary
extrudate with in the exit die for that portion of the
multi-component extrusion. The base capstocking conduit
48 and side capstocking conduits 50 feed a thin layer of
15 the capstock material on the primary extrudate flowing
in the primary 40 while the materials are within the
first capstock plate 28. Thus the inventive method and
extrusion apparatus has the prong capstocking conduit 44
meeting the primary conduit 40 within the exit die plate
20 30 where the primary extrudate has already been coated
with a thin layer of capstocking extrudate by base
capstocking conduit 48. Thus, the prongs 16,17 of
Figure 1 are attached to the base capstock layer already
attached to the primary extrudate.

25 The flow of the primary extrudate and the
capstocking extrudate within the capstocking conduits
42, 44, 46, and 48 can be more readily seen in Figure 5.
Figure 5 is a representation of the flow of the primary
extrudate and the capstocking extrudate through the die
30 assembly 23. Primary capstocking conduit material is
shown at reference numeral 142. Top capstocking conduit
material 146 is fluidly connected to the primary
capstocking conduit material 142. Base capstocking
conduit material is shown at reference numeral 148.

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TABLE I
SAN/Wood Flour Foamed Composite

	INGREDIENT	PERCENT (by weight)	SUPPLIER	CITY	STATE
	SAN Resin	70-90	Kumho		South Korea
5	Wood Flour	2-25	American Wood Fiber	Schofield	Wisconsi n
	ABS Modifier	2-8	GE	Morgantow n	West Virginia
	Lubricant	0.1-0.5	Synpro	Cleveland	Ohio
10	Foaming Agent	0.5-3.0	Color Matrix	Cleveland	Ohio

Table I discloses a suitable primary extrudate in the form of a foamable SAN and wood flour composite feedstock material. A suitable SAN resin product available from Kumho is "SAN 350." A suitable wood flour product available from American Wood Fiber is the "4060" product which is a 60 mesh wood flour product (i.e., a product where the largest particle size will sift through a 60 mesh screen). A suitable ABS modifier available from GE is the HR-181 product. A suitable foaming agent available from Color Matrix is the "Foamazol F-92" product.

TABLE II
PVC Capstock Formulation

	INGREDIENT	PERCENT (by weight)	SUPPLIER	CITY	STATE
25	PVC Resin (SE-650)	76.161	Shintech	Freeport	Texas

0	Stabilizer	0.610	Witco	Taft	Louisiana
	401P	0.228	PQ	Kansas	Kansas
			Corporation	City	
	Lubricant	2.44	Cognis	Kanakee	Illinois
	(VGE-3041)				
5	Anti-	0.38	Clariant		Germany
	static				
	Modifier	4.95	Kaneka	Pasadena	Texas
	(K-37)				
	Calcium	3.04	OMYA	Florence	Vermont
	Carbonate				
10	Titanium	7.62	Huntsman	Lake	Louisiana
	Dioxide		Tioxide	Charles	
	Calcined	4.57	Burgess	Sandersvi	Georgia
	Clay			lle	

15 Table II discloses a suitable capstocking extrudate
for use in the herein disclosed invention.

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